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► To cite this version:

Ingmar Schumacher. On the Self-Fulfilling Prophecy of Changes in Sovereign Ratings. 2012. hal-00668284

HAL Id: hal-00668284

<https://hal.science/hal-00668284>

Preprint submitted on 9 Feb 2012

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ÉCOLE POLYTECHNIQUE
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

ON THE SELF-FULFILLING PROPHECY OF CHANGES
IN SOVEREIGN RATINGS

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February 2012

Cahier n° 2012-02

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On the Self-Fulfilling Prophecy of Changes in Sovereign Ratings*

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February 3, 2012

Abstract

We empirically investigate the dynamic interactions between sovereign ratings and the macroeconomic environment. We use a Panel VAR on annual data for European countries from 1986-2010. Our results provide evidence for a significant two-way interaction between the macroeconomic environment and changes in sovereigns' ratings. Thus, rating changes are able to exacerbate a country's boom-bust cycle.

Keywords: sovereign ratings; Panel VAR; self-fulfilling prophecy.

JEL classification: C33; H6.

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1 Introduction

The recent changes in sovereign ratings have received considerable attention from policy makers and researchers alike. Often, changes in ratings are believed to induce a self-fulfilling prophecy. For example, fears mounted that governments which are going through a period of crisis would be additionally adversely affected by rating downgrades. As a consequence, downgrades would induce a self-fulfilling prophecy of instability. Evidence is mounting that suggests significant effects from changes in ratings to macroeconomic conditions, especially bonds and stock prices as well as defaults (e.g. Cantor and Packer 1996, Kaminsky and Schmukler 2002, Reinhart 2002, Brooks, Faff, Hillier and Hillier 2004, Ferreira and Gama 2007), but also from macroeconomic conditions to changes in ratings (e.g. Afonso, Gomes and Rother 2011, Hilscher and Nosbusch 2010, Mellios and Paget-Blanc 2006). However, the studies just cited focus on either the effect of ratings on macroeconomic variables or the other way around.¹ In contrast, a study of the self-fulfilling prophecy would require an integrated framework, allowing for two-way feedbacks between changes in ratings and changes in macroeconomic conditions. Our contribution in this article is, thus, to study these feedbacks within a Panel VAR framework.

There have recently been some contributions that question whether changes in ratings are able to exacerbate a country's boom-bust cycle, since they find that changes to ratings were mainly reactions to news (Mora 2006). Our panel VAR analysis allows us to investigate this question more fully. In particular, the main result of our study is that we find a significant two-way interaction between our macroeconomic variables and changes in sovereigns' ratings, suggesting that ratings are, indeed, able to exacerbate a country's boom-bust cycle.

¹Cantor and Packer (1996) study both but not in a dynamic, interactive way.

2 Data and Methodology

Our data consists of consumer sentiment (CCI), Gross Domestic Product (GDP), Government Deficit (GD) and Population, all of which come from Eurostat, while the data on the ratings is taken from Fitch’s Complete Sovereign Rating History and Bloomberg. We focus on European countries since their data is fully harmonized and thereby comparison is facilitated and meaningful.

The ratings data comes from Fitch, S&P as well as Moody’s and it is the sovereign long-term rating. We recode the rating in a numerical form, ranging from 0 for DD to 22 for AAA for Fitch, from 0 for D to 22 for AAA in the case of S&P, and from 0 for C to 22 for Aaa in the case of Moody’s. We take the average of the three ratings for each country at each point in time in order to obtain a balanced picture. In case there are several changes in a sovereign’s rating within one year we weigh each rating by the number of days that the rating was active during that year. We then calculate the growth rate of the rating (in percentage), denoted by $\mathbf{g}(\mathbf{R})$, in order to obtain a variable that better fits within the econometric approach of the Panel VAR (i.e. is essentially unbounded). A sovereign’s rating has been related to its probability of default and economic soundness (Reinhart 2002). Thus, changes in ratings should drive investors’ expectations on their potential returns and household expectations on their future income. Additionally, changes in ratings affect a sovereign’s cost of financing its budget deficit (Brooks et al. 2004). In consequence, we also expect rating changes to impact a sovereign’s deficit.

The variable $\mathbf{d}(\mathbf{CCI})$ gives the change in the harmonized consumer sentiment index. As described in the background document of the European Commission, (European Commission 2007), the CCI “is the arithmetic average of the balances (in percentage points) of the answers to the questions on the financial situation of households, the general economic situation, unemployment expec-

tations (with inverted sign) and savings, all over the next 12 months.” Thus, it is a forward-looking index of the household’s perception on the developments of their financial situation. With this variable we capture the expectations of the households in our sample. We anticipate that changes in their sovereign’s rating should impact their expectations positively.

As the main indicator for the current economic situation we use the growth rate of GDP per capita. GDP is measured in market prices in Millions of Euro. We calculate the growth rate of GDP per capita in percentage terms and denote it by $\mathbf{g(GDPpc)}$. We expect a positive impact from $\mathbf{g(GDPpc)}$ on a sovereign’s rating, but a negative impact from changes in a sovereign’s rating on its GDP growth.

The government deficit is the deficit of the general government and measured as total expenditure minus revenue. We calculate it relative to GDP in order to minimize scale effects² and denote changes in this variable as $\mathbf{d(GD/GDP)}$. Also, this provides us with information on the size of the budget deficit relative to that of the national economy. This is the only way in which one can quantify whether a deficit is actually ‘large’. In line with the recent observations, we expect rating downgrades to follow shocks to $\mathbf{d(GD/GDP)}$. Furthermore, given previous results in the literature we anticipate that government deficits decrease following rating upgrades.

Based on this data, our sample consists of 26 European countries, namely Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom.³

²The results stay essentially unchanged if we use the per capita deficit.

³In the Robustness Appendix we exclude those countries that did not have a rating change during the period of study. We show that this does not lead to qualitative changes to the results.

This gives us an unbalanced dataset consisting of at maximum 363 country-year observations ranging from 1986 to 2010. The use of the annual data should minimize potential anticipation effects of fiscal policy changes (Ramey, 2006) and help us in avoiding spurious results due to cyclical effects. The summary statistics are provided in Table 1, and the correlations in Table 2.

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.
d(GD/GDP)	0	1.711	-6.738	5.945
g(GDPpc)	0	5.13	-18.564	19.262
d(CCI)	0	6.249	-23.43	18.836
g(R)	0	2.768	-17.983	14.454

Looking at the correlations in Table 2 reveals all are significant at the 5% significance level, apart from the correlations between d(CCI) and d(GD/GDP) and g(GDPpc) and d(GD/GDP), which are uncorrelated. Changes in consumer sentiment are positively correlated with per capita GDP growth (0.21). Changes in a sovereign's rating are negatively correlated with changes in its budget deficit (-0.119) but positively with changes in consumer sentiment (0.247).

Table 2: Cross-correlation table

Variables	d(GD/GDP)	g(GDPpc)	d(CCI)
g(GDPpc)	-0.001 (0.986)		
d(CCI)	0.043 (0.419)	0.210 (0.000)	
g(R)	-0.119 (0.024)	0.422 (0.000)	0.247 (0.000)

As our estimation strategy we resort to a Panel Autoregressive Regression (PVAR) with two lags.⁴ Since we expect all variables to be at least weakly endogenous we resort to the reduced-form VAR approach as this avoids impos-

⁴The Robustness Appendix shows that the number of lags does not influence the results.

ing a detailed structural model. Furthermore, the VAR approach allows us to identify the dynamic effects of our variables, which we argued in the previous section to be important for understanding the full interaction between rating changes and macroeconomic variables. It furthermore allows us to isolate the individual effects of each variable via orthogonalized impulse responses, which we decompose based on the Cholesky decomposition (see e.g. Hamilton 1994). We estimate the model itself via system GMM based on the STATA routine provided by Inessa Love (see Love and Zicchino 2006). Firstly, we time demean the series,⁵ which controls for time-specific effects. Secondly, we helmert transform the variables, which is a forward mean-differencing of the variables in order to take away fixed effects without introducing serial correlation.

We choose the ordering $\{d(\text{GD}/\text{GDP}), g(\text{GDPpc}), d(\text{CCI}), g(\text{R})\}$. Due to the Cholesky decomposition, a variable is allowed to react in the same period to all variables ordered before it, but does not contemporaneously react to any of the variables ordered after it.⁶ Our ordering is based on the view that the government deficit impacts GDP directly (e.g. Ramey 2011), and that the ratings are responding to macroeconomic conditions only contemporaneously (e.g. Mora 2006). Thus, we align ourselves with the results in Mora (2006), namely that ratings react to news, and thereby set the stage against a contemporaneous feedback from ratings to macroeconomic variables. If we, even in this case, find evidence in favor of a two-way relationship, then this would provide the strongest support for the self-fulfilling prophecy.

⁵This is done via calculating the average of each variable at each point in time, and then subtracting these from the actual variables.

⁶In the Robustness Appendix we discuss that the results are not qualitatively affected by the ordering.

3 Results

The results for the variance decomposition are shown in Table 3, while the impulse response results are presented in Figure 1. The impulse responses use 5% confidence bands generated by Monte Carlo simulations with 1000 replications. Overall, we find significant dynamic interactions between changes in countries' ratings and their macroeconomic environment, providing support for the self-fulfilling prophecy.⁷

Table 3: Variance decomposition

Equation	d(GD/GDP)	g(GDPpc)	d(CCI)	g(R)
d(GD/GDP)	98.92	0.30	0.11	0.66
g(GDPpc)	1.50	84.43	2.28	11.79
d(CCI)	4.55	7.49	84.21	3.75
g(R)	2.40	3.50	10.07	84.03

In particular, our results show that 84% of the variance in sovereign ratings changes can be attributed to an own shock, while the rest of the variance is explained by changes in a sovereign's government deficit (2.4%), by per capita GDP growth (3.5%) and by changes to consumer sentiment (10.07%). Thus, though in line with the previous literature on the sustainability of government finances (e.g. Afonso et al. 2011), we also find a relevant role for per capita GDP growth and for expectations.

> Figure 1 about here <

The impulse responses in Figure 1 show significant feedbacks from the macroe-

⁷In the Robustness Appendix we present the complete robustness studies. We studied stationarity, all variables were stationary at any lag length with or without trends. We excluded all those countries that did not have a rating change during our period of study (Austria, France, Germany, Luxembourg, Netherlands, United Kingdom), without a change to the results. We changed the ordering of the variables and varied the lag structure and included additional controls. We used the variables without controlling for time-specific effects and we also did not helmert transform them. All of these did not affect the main results of our analysis.

conomic variables to changes in the ratings. The effect of changes in a country's GDP growth rate is short-run and impacts a country's rating only contemporaneously. A one percentage point increase in a country's GDP growth rate increases the growth rate of that country's rating by 0.4 percentage points. Changes to consumer sentiment lead to a statistically significant and long-term increase in a sovereign's rating. Here we find that a one standard deviation increase in consumer sentiment raises a country's growth rate of its rating by roughly 0.5 percentage points. Though marginally statistically insignificant, we find a sovereign's rating growth will be reduced following a one standard deviation increase in that country's government deficit-to-GDP ratio.⁸

The effects from changes in ratings to a country's macroeconomic environment are also non-negligible. The results indicate that changes in ratings can explain 0.66% of the variance in the government deficit, 3.75% of the changes in consumer sentiment, and up to 11.79% of the variance in the country's per capita GDP growth rate.

Our impulse response results show that both per capita GDP growth and changes in consumer sentiment are significantly positively related to changes in ratings. We find that the effect of rating changes on per capita GDP growth works its way through changes in consumer sentiment. A one percentage point increase in a country's growth rate of its rating increases per capita GDP growth by roughly 1.1 percentage points after two years, while its consumer confidence increases by approximately 1.2 points within one year. A country's government deficit marginally increases after an increase in its rating. We find that a one percentage point increase in a country's growth rate of its rating increases a country's deficit-to-GDP ratio by roughly 0.15 points. This effect arises after two years but it is short-term. Hence, we conclude that there is evidence

⁸In our Robustness Appendix we show that this effect may become statistically significantly different from zero depending on the time period, the sample or the transformation we apply to the variables.

that changes in ratings may induce countries to take a more sustainable fiscal position.

4 Conclusion

In this article we find evidence for the self-fulfilling prophecy caused by changes in sovereigns' ratings, suggesting that ratings are, indeed, able to exacerbate a country's boom-bust cycle. Thus, ratings seem to have a similar impact as marking-to-market of balance sheets. While marking-to-market of balance sheets may lead to fire sales and additional rounds of feedbacks between asset sales and asset prices (Plantin, Sapra and Shin 2008), thereby potentially rendering an otherwise sound institution illiquid, rating changes may exacerbate a sovereign's boom-bust cycle by two-way feedbacks between its rating and its macroeconomic condition.

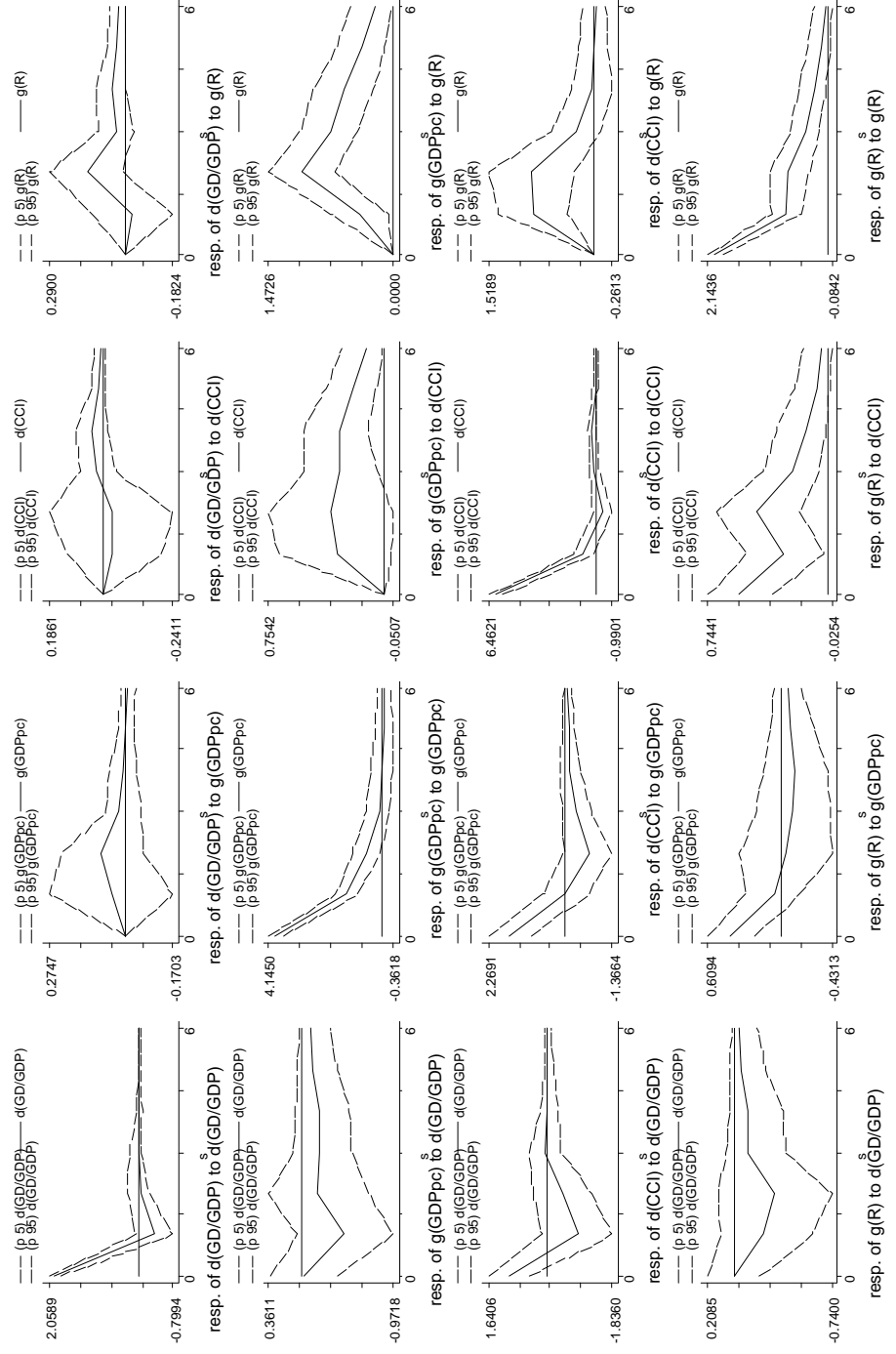
The obvious advantage of sovereign ratings is that they provide debt holders and investors with an idea about the probability of a sovereign's default. Another advantage is that rating downgrades will place pressure on governments to address structural problems that otherwise might get postponed and potentially result in larger costs than those incurred by immediately tackling the problems. The disadvantage, as we have shown, arises from the fact that changes in ratings can induce a downward spiral and essentially aggravate existing problems. To find the welfare trade-offs between the advantages and the disadvantages as well as potential policy solutions should prove to be a fruitful future research agenda.

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Figure 1: Impulse responses



ROBUSTNESS APPENDIX to

On the Self-Fulfilling Prophecy of Changes in Sovereign

Ratings

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February 3, 2012

Abstract

We empirically investigate the dynamic interactions between sovereign ratings and the macroeconomic environment. We use a Panel VAR on annual data for European countries from 1997-2010. Our results provide evidence for a significant two-way interaction between the macroeconomic environment and changes in sovereigns' ratings. Thus, rating changes are able to exacerbate a country's boom-bust cycle.

Keywords: sovereign ratings; Panel VAR; self-fulfilling prophecy.

JEL classification: C33; H6.

This is the robustness appendix to the article entitled “On the Self-Fulfilling Prophecy of Changes in Sovereign Ratings”. In Table 1 we present panel data unit root tests based on the Fisher test (see Baltagi (2005)). Table 1 shows that all variables are stationary.

Table 1: Fisher-type unit root tests

1 lag				
	d(GD/GDP)	g(GDPpc)	d(CCI)	g(R)
Inverse chi-squared	430.14	176.1	285.83	125.71
p-value	0.00	0.00	0.00	0.00
Mod. inv. chi-squared	36.19	11.75	22.3	6.9
p-value	0.00	0.00	0.00	0.00
1 lag and trend				
	d(GD/GDP)	g(GDPpc)	d(CCI)	g(R)
Inverse chi-squared	374.53	137.32	201.36	164.6
p-value	0.00	0.00	0.00	0.00
Mod. inv. chi-squared	30.8	8.01	14.18	10.65
p-value	0.00	0.00	0.00	0.00

H0: All panels contain unit roots. Results hold with any number of lags.

We checked whether our results were not driven by the last crisis. Thus, we dropped the observations from 2008 onwards and re-ran the analysis based on this sub-sample. The results, shown in 1, are qualitatively the same. However, the response the growth rate in ratings to the growth of GDP per capita is now more pronounced and is statistically significantly different from zero from one year after the shock to GDP per capita until six years after the shock. In addition, the growth rate of the ratings is now statistically significantly affected by a shock in the deficit-to-GDP ratio.

As an additional robustness check we varied the lag structure. In Figure 2 we present the model with one lag, while in Figure 3 we present the results with three lags. Again, we find no remarkable changes to our results above.

The assumed ordering tends to be important for the impulse responses due to the Cholesky decomposition. Thus, we inspected the robustness of the results with alternative orderings of the variables, some of which we present in Figure 4 and 5. The ordering in Figure 4 is $\{g(R), d(CCI), d(GD/GDP), g(GDPpc)\}$, while the one in Figure 5 is $\{d(CCI), g(R), g(GDPpc), d(GD/GDP)\}$. We find that the only relevant difference arises in the response of the growth rate in the rating to that in GDP per capita. Basically, if the growth in GDP per capita cannot contemporaneously affect the growth rate in the ratings, then the ratings will be unaffected by a shock to GDP per capita. Apart from this we find no important qualitative differences in the results, indicating that the ordering has no significant impact on our analysis.

We then constrained the sample to only include those countries that had changes in their ratings during the period of observation. The impulse responses for that case are shown in Figure 6. Our results are unchanged and the analysis is fully robust to the exclusion of those countries.

As an additional robustness analysis we include further variables. Omitted variable bias is one way in which results in a VAR could be biased. We, thus, include two additional controls, the inflation rate and changes in the balance of payments relative to GDP. The impulse response results are shown in Figure 7. The inflation rate has been found to be one determinant of ratings (see e.g. Cantor and Packer 1996). We find a negative relationship between HICP and changes in ratings, and thus confirm the results in Cantor and Packer (1996). The variable balance of payments accounts for outflows or inflows of goods and capital. While we find that there is a two-way relationship between balance of payments and ratings, we also observe that our previous results remain unchanged.

As a further robustness analysis we cut all variables at the 1% and 99% tails. In this way we analyze whether potential outliers may drive our results. This reduces the sample by 39 observations. The results are presented in Figure 8. We find that now the growth rate of the ratings responds not only negatively but also statistically significantly different from zero to a shock in the deficit-to-GDP ratio. In contrast, while the response of the growth rate in ratings to per capita GDP growth is still positive, it is not statistically different from zero any longer.

As final robustness exercises we do not time de-mean the series in order to see whether our results may be robust without taking care of time-specific effects. The impulse responses of this are shown in Figure 9. Our results continue to hold. In addition, we find a much stronger statistically significant relationship between ratings and the deficit-to-GDP ratio. Specifically, we find that a shock to ratings growth now decreases the deficit-to-GDP ratio, while an increase in sovereign's deficit-to-GDP ratio reduces its ratings. It is possible that this statistically stronger result is driven by the responses of consumer sentiment and per capita GDP, which now react negatively and statistically significantly different from zero to a shock in its sovereign's deficit-to-GDP ratio.¹ In Figure 10 we present the impulse responses of our model without time de-meaning and without using fixed effects. The response of the growth rate in ratings to a shock in the deficit-to-GDP ratio is now even stronger. It is possible that this is driven by the stronger response of the per capita GDP growth to a shock in the deficit-to-GDP ratio. Since this effect is absent when one time de-means the data, then we conclude that this result may be driven by time-specific effects.

¹The negative impact of the deficit-to-GDP ratio on GDP growth has also been found in Brückner and Pappa (2010) and Juessen and Linnemann (2012).

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Figure 1: Robustness of impulse responses: Excluding recent crisis (i.e. $T < 2008$)

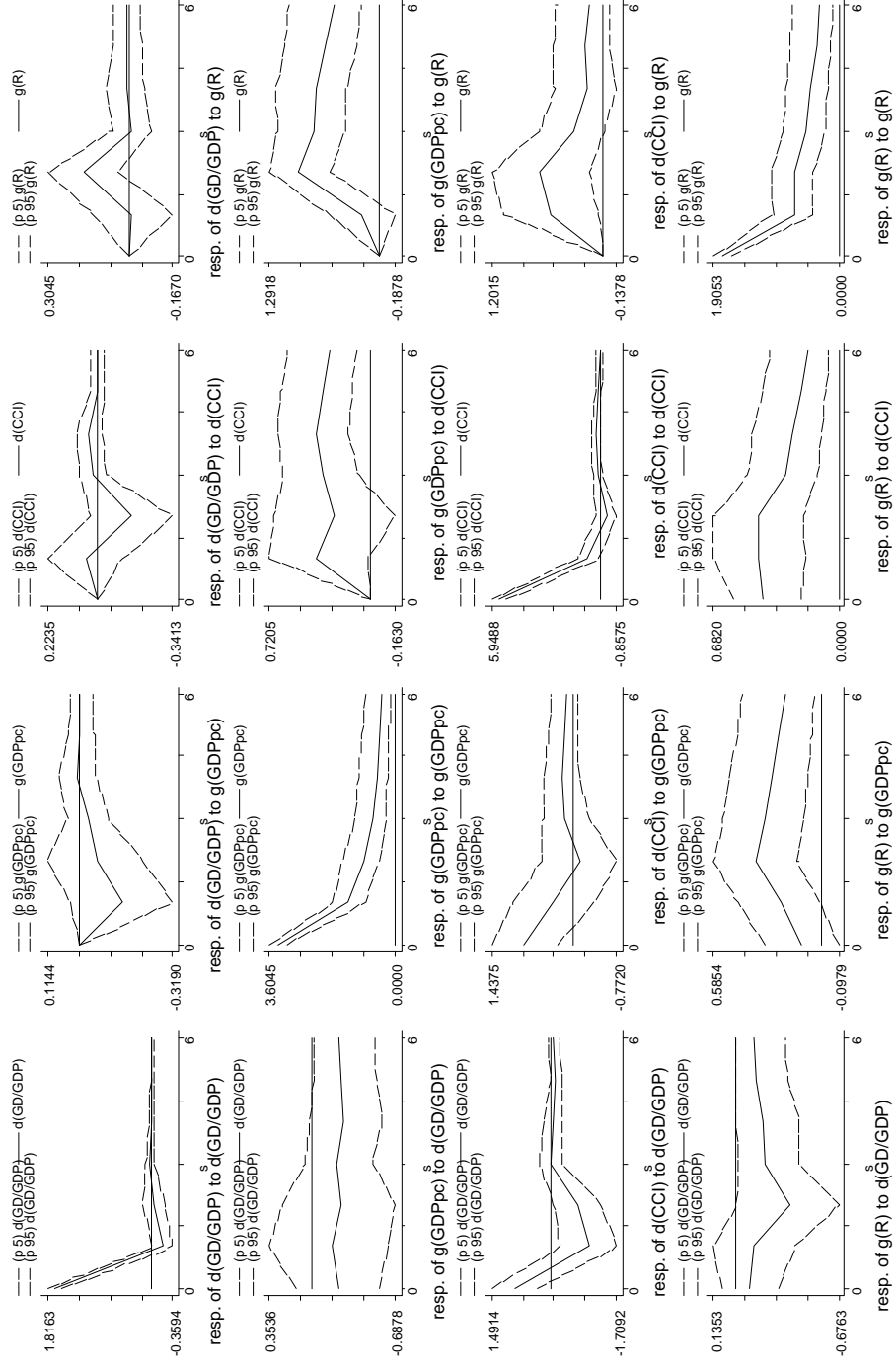


Figure 2: Robustness of impulse responses: Changing lags (lag = 1)

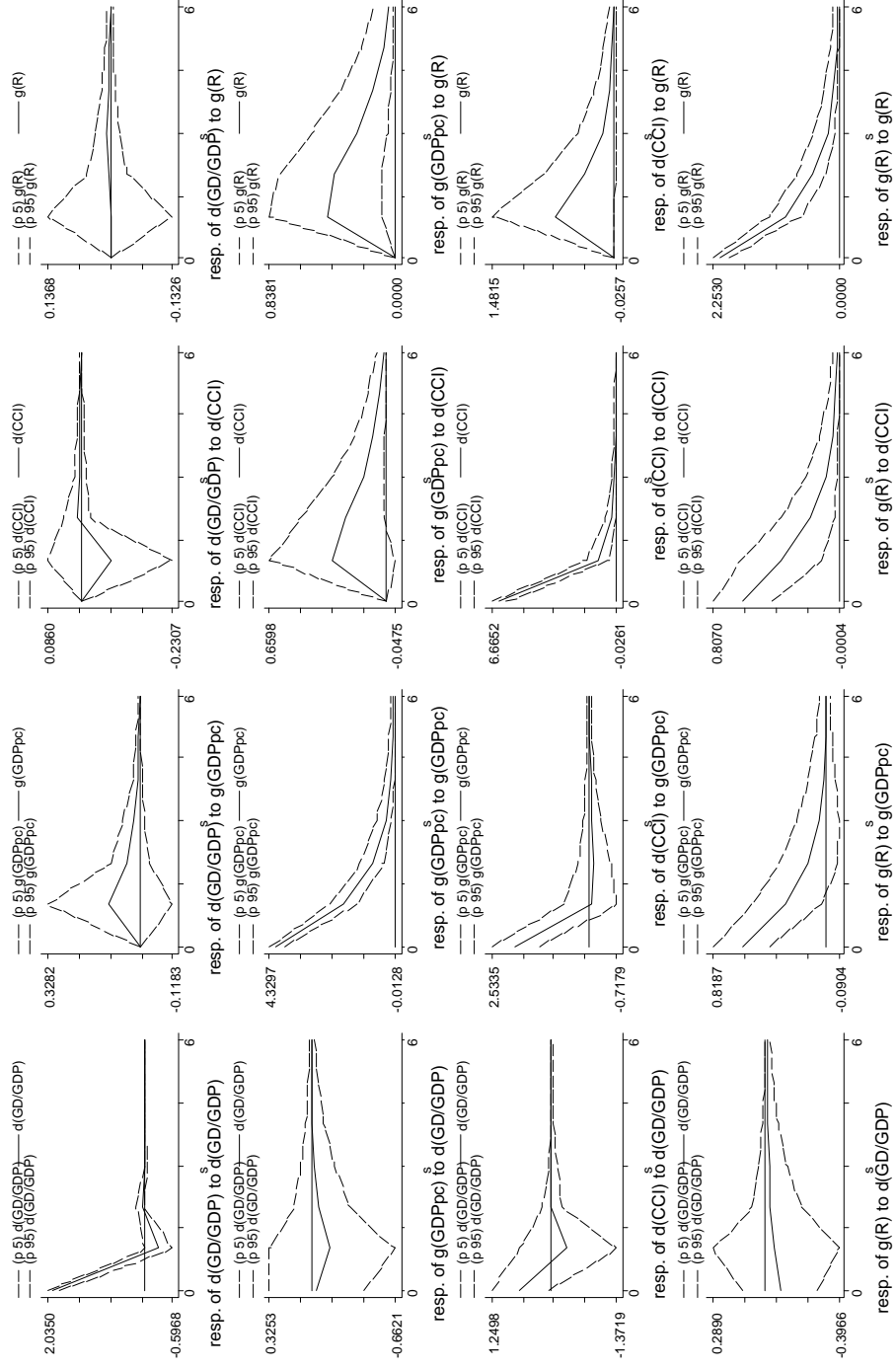


Figure 3: Robustness of impulse responses: Changing lags (lag = 3)

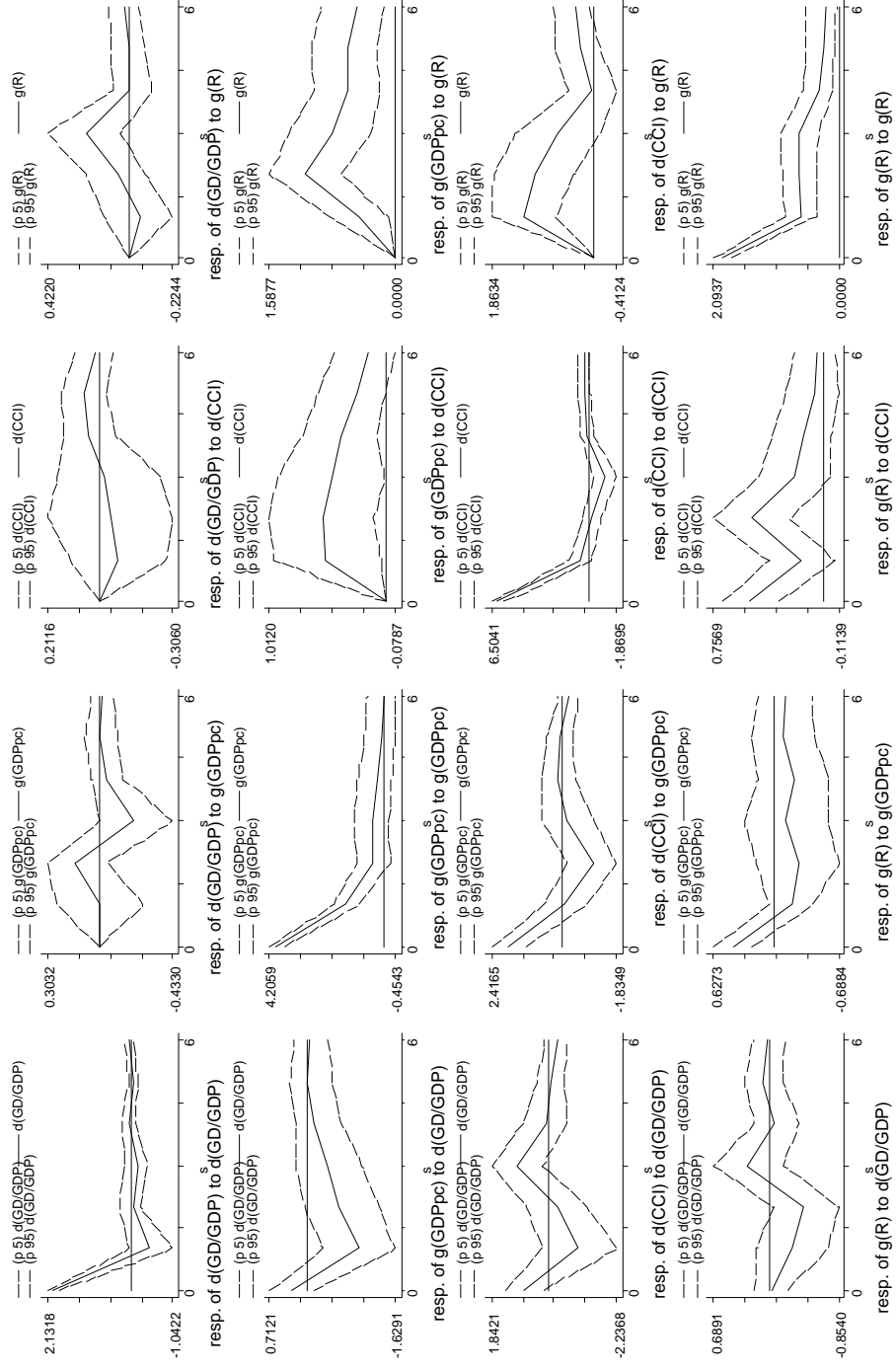


Figure 4: Robustness of impulse responses: Order $\{ g(R), d(CCI), d(GD/GDP), g(GDPpc) \}$

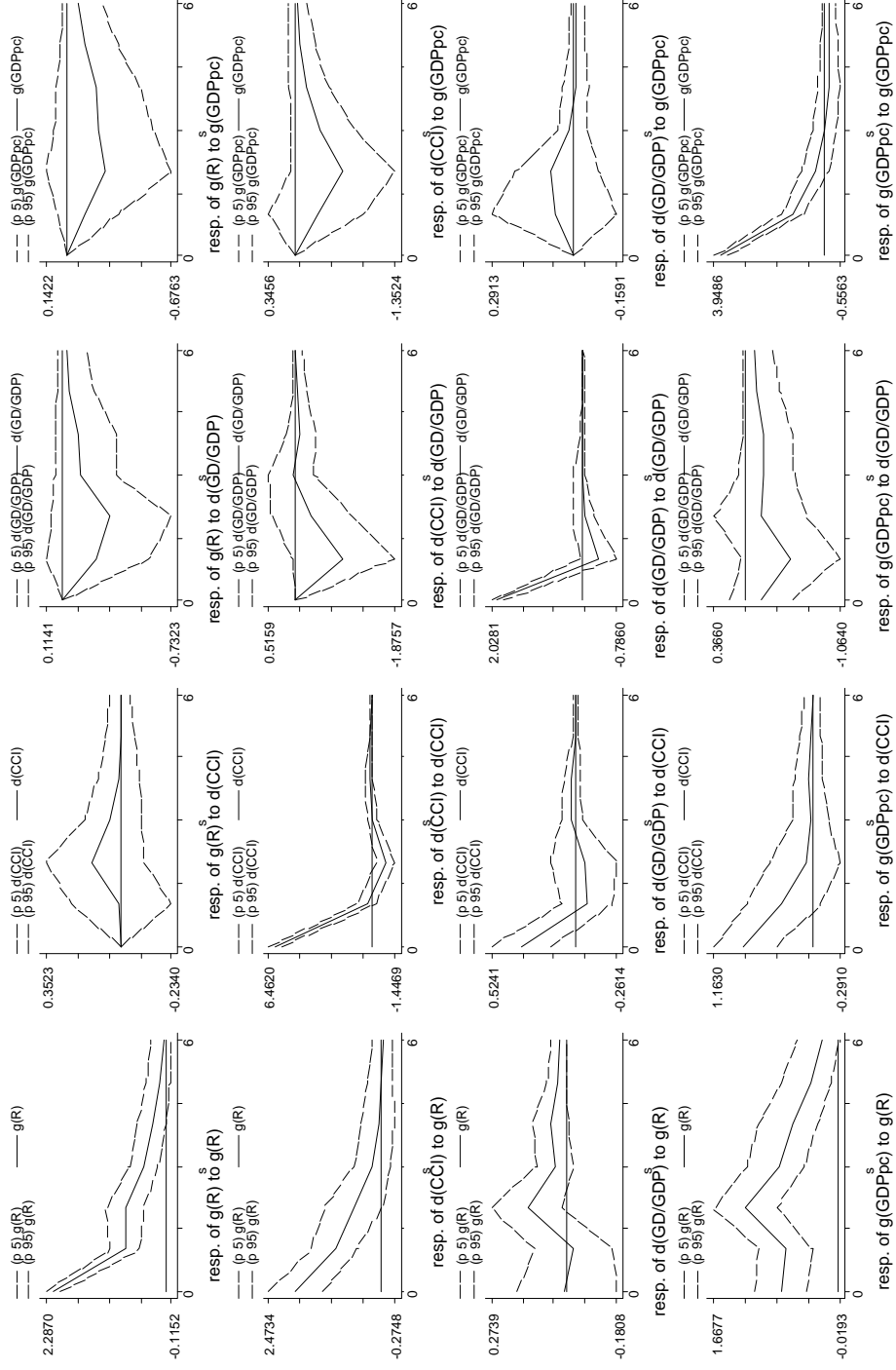


Figure 5: Robustness of impulse responses: Order $\{d(CCT), g(R), g(GDPpc), d(GD/GDP)\}$

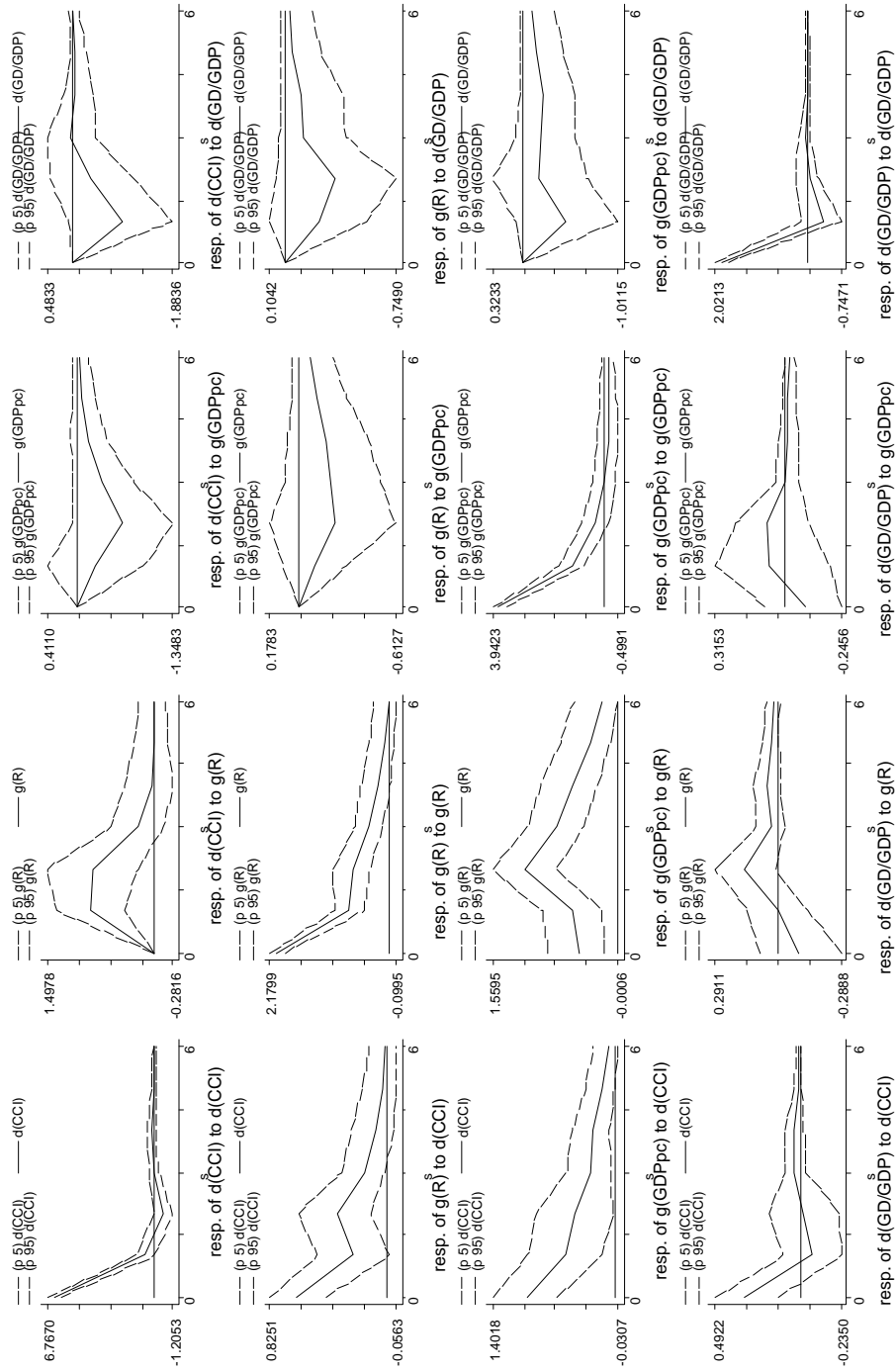


Figure 6: Robustness of impulse responses: Excluding countries with no rating changes

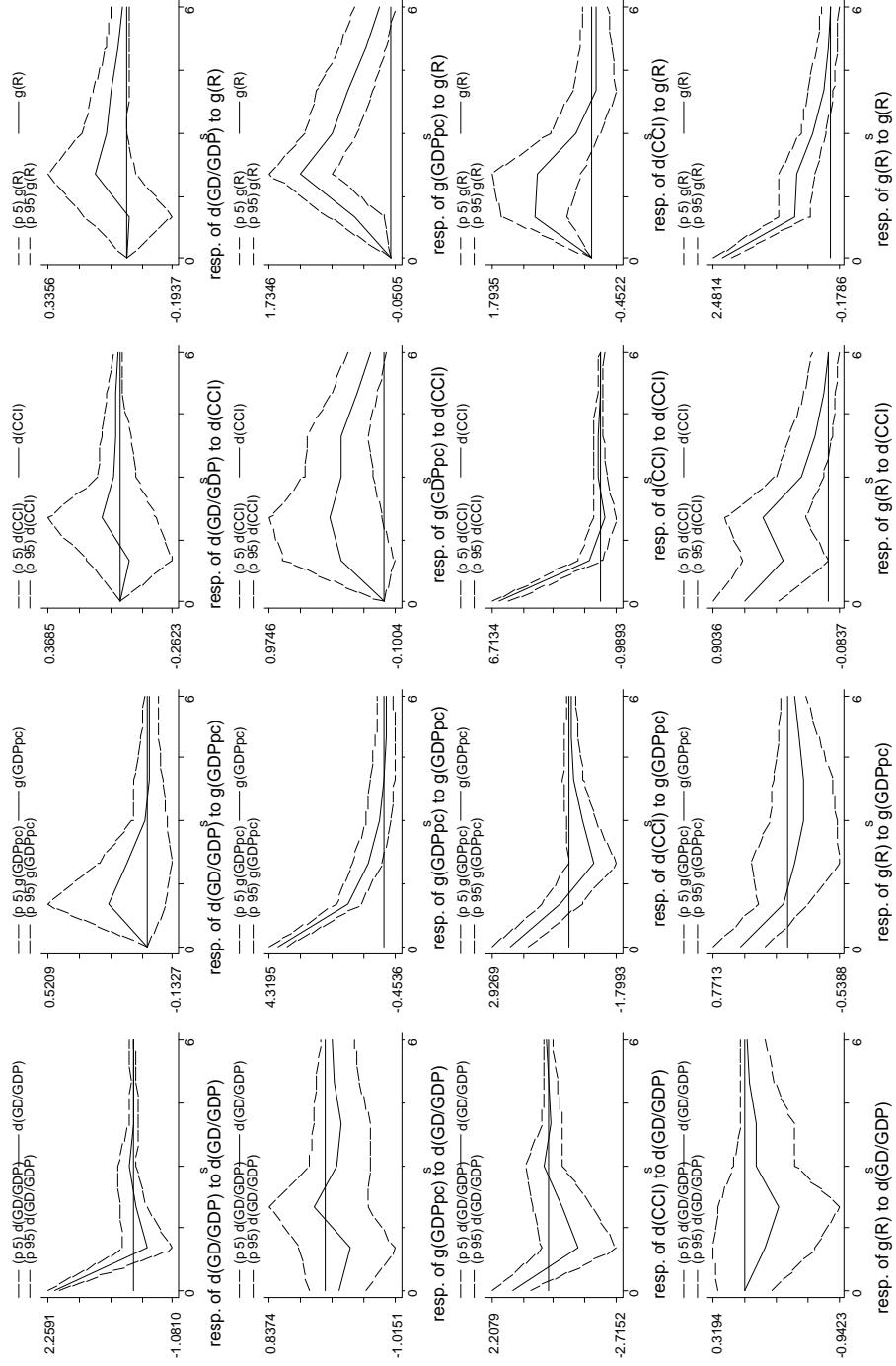


Figure 7: Robustness of impulse responses: Additional controls

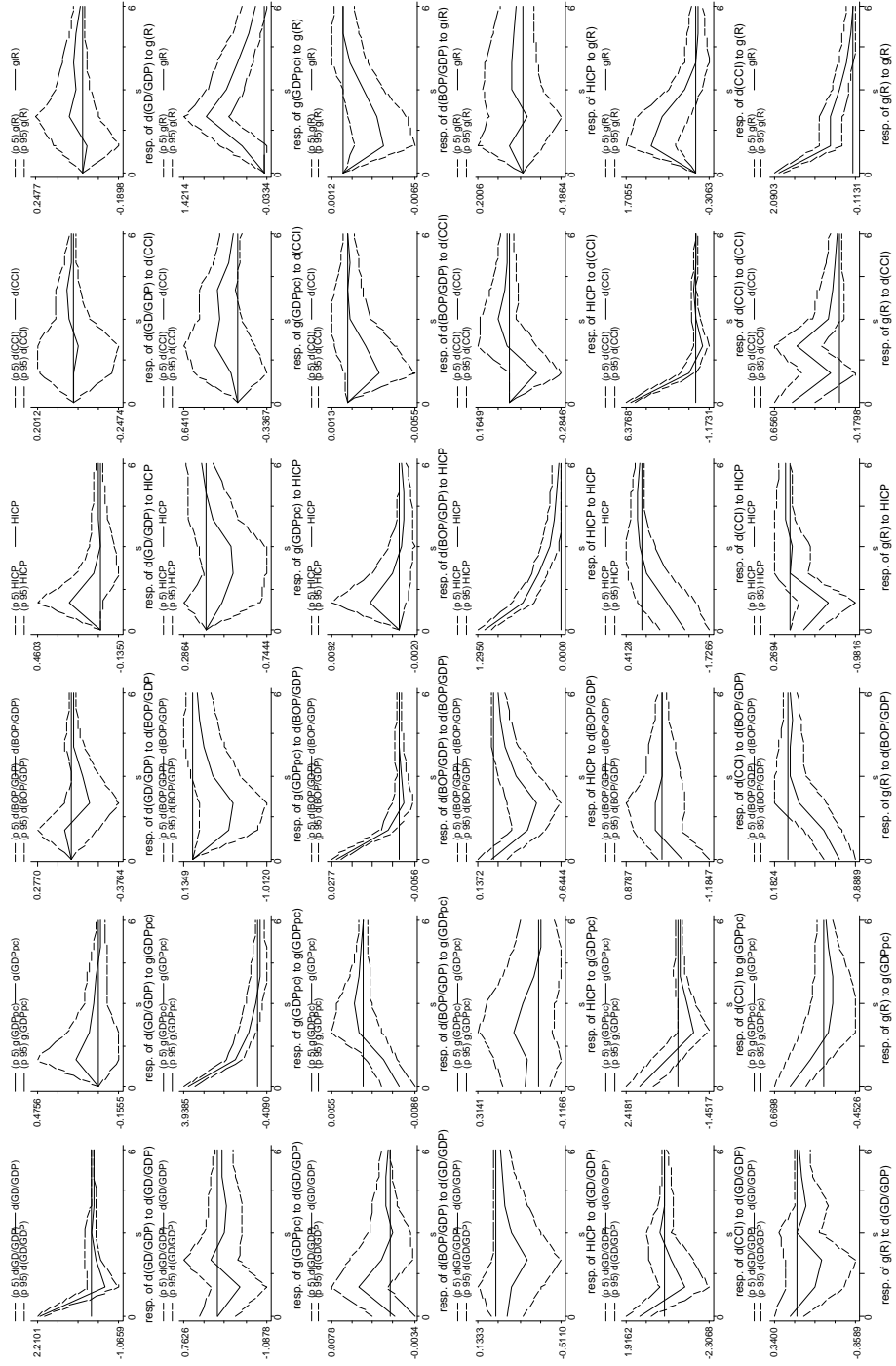


Figure 8: Robustness of impulse responses: Cutting 1% and 99% tails

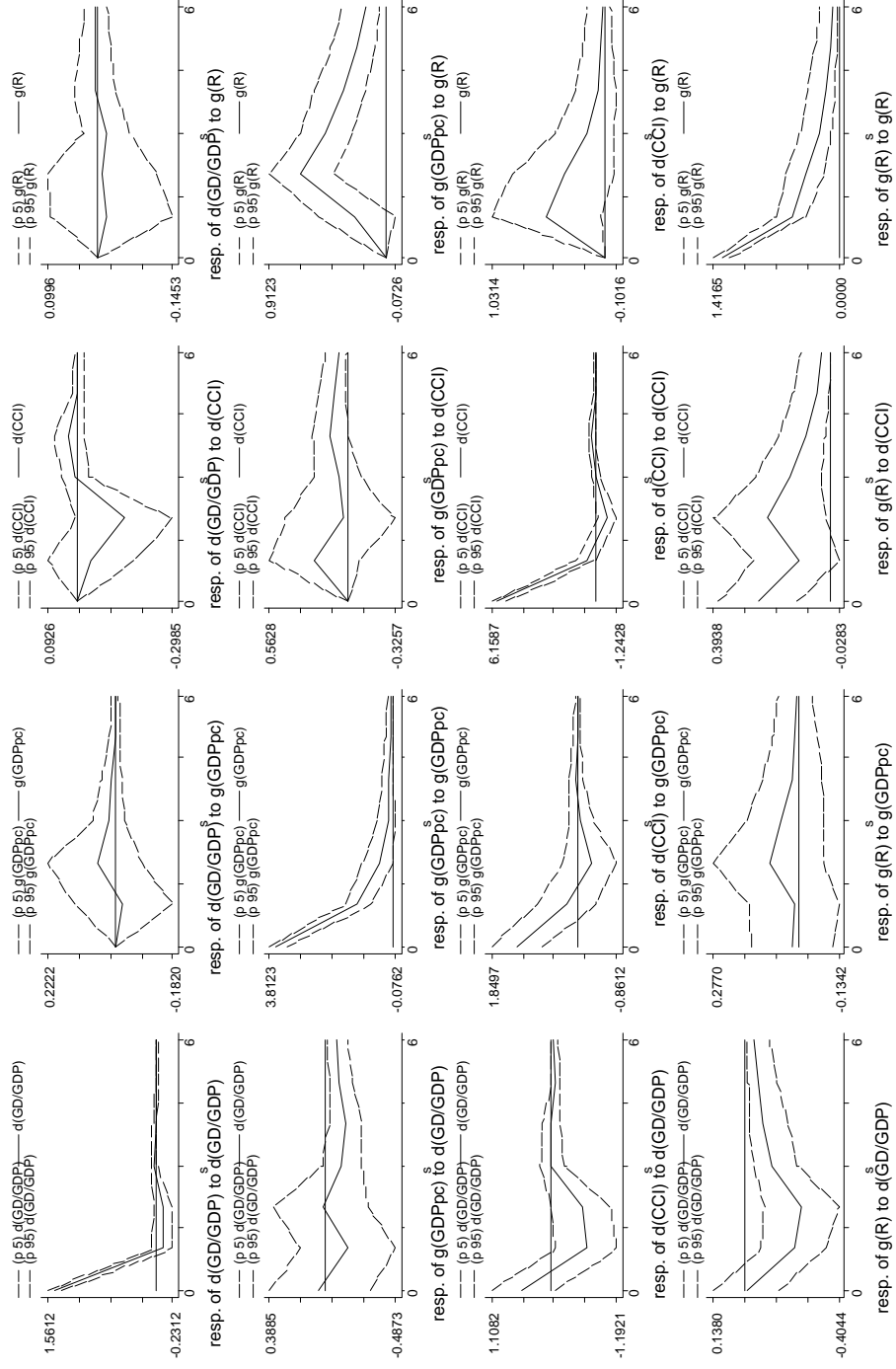


Figure 9: Robustness of impulse responses: Without time de-meaning

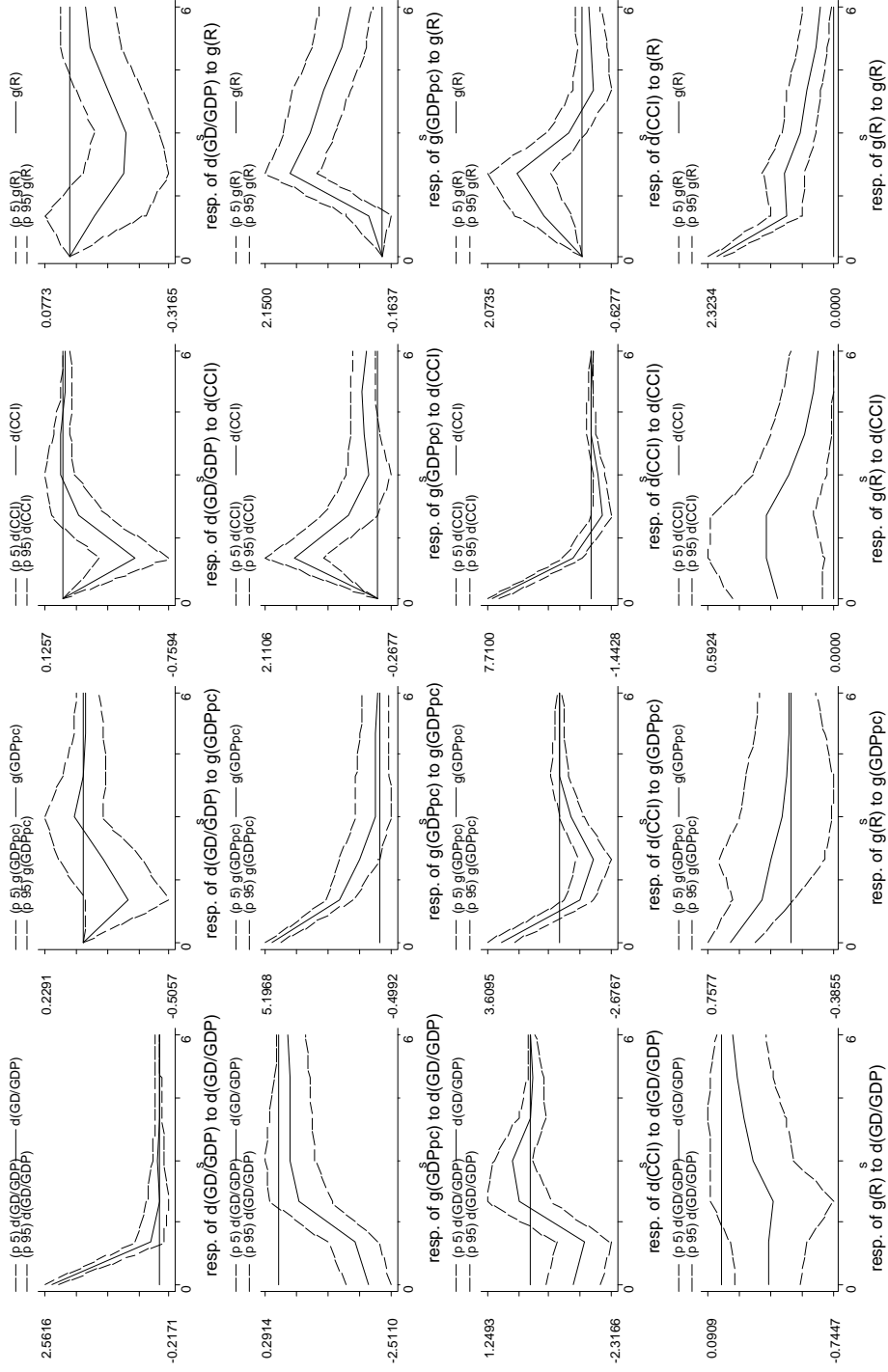


Figure 10: Robustness of impulse responses: Without time de-meaning and without fixed effects

